



Teaching of Mathematics and Science in English: The Teachers' Voices

Mohamad Fadhili Bin Yahaya

Academy of Language Studies, Universiti Teknologi MARA

02600 Arau, Perlis, Malaysia

Tel: 60-12-455-5164 E-mail: mohdfadhili@perlis.uitm.edu.my

Mohd Asri Bin Mohd Noor

Faculty of Business and Economics, Universiti Perguruan Sultan Idris

35900 Tanjong Malim, Perak Malaysia.

Tel: 60-5-450-6271/6279 E-mail: m-asri@upsi.edu.my

Ahmad Azman Bin Mokhtar

Academy of Language Studies, Universiti Teknologi MARA

02600 Arau, Perlis, Malaysia

Tel: 60-12-661-3064 E-mail: ahmadazman@perlis.uitm.edu.my

Rafizah Binti Mohd Rawian

Academy of Language Studies, Universiti Teknologi MARA

02600 Arau, Perlis, Malaysia

Tel: 60-12-363-0455 E-mail: Rafizahmr@perlis.uitm.edu.my

Mahmod Bin Othman

Faculty of Computer Science and Mathematics, Universiti Teknologi MARA

02600 Arau, Perlis, Malaysia

Tel: 60-16-594-0250 E-mail: mahmod135085@perlis.uitm.edu.my

Kamaruzaman Jusoff (Corresponding author)

Faculty of Forestry, Universiti Putra Malaysia, 43400 Serdang, Selangor. Malaysia

Tel: 60-3-8946-7176 E-mail: kjusoff@yahoo.com

Abstract

The policy to change the medium of instruction in the teaching of Mathematics and Science from Bahasa Melayu (Malay Language) to English in 2003 is an important innovation affecting not only the students but also teachers of Mathematics and Science. However, how far do the changes affect the teachers is the issue addressed in the paper. In fact the objectives of the study were to investigate the reaction of the mathematic and science teachers to using English as the medium of instruction, the problems encountered by these teachers in using English in the classroom and the availability of language support systems. A study was conducted on a group of pre-university educators in the northern part of Malaysia who have undergone language enhancement courses known as English for the Teaching of Mathematics and Science (ETeMS). The study reveals that teachers of mathematics and science are generally perceptive of the change in the medium of instruction but needing some sustainable measures to not only improve their language ability and delivery. Thus it is hope that certain measures would be taken to address on teachers struggle to ensure the success of the policy.

Keywords: Mathematics, Science, English, Teaching, Learning

1. Introduction

In January 2003 Malaysia took a bold step in re-adopting the English language as a medium of instruction for mathematics and science in order to ensure that Malaysians are able to keep abreast with scientific and technological development that is mostly recorded in the English language and to provide opportunities for students to use the English language and therefore increase their proficiency in the language (Ministry of Education, 2002a).

The change in policy is congruent to significant developments and understandings in second language acquisition that emphasise the role of meaningful, understandable input. In this case, teaching mathematics and science in English provides a rich context for genuine language use and as such serves as a focal point around which oral language and literacy in English can develop (Kessler & Quinn, 1987). Whilst this move may be seen as desirable and progressive, it is one that changes the dynamics of teaching and learning mathematics and science in the Malaysian classroom.

Teachers who have been teaching and learning in Bahasa Melayu are expected to perform effectively in English, to teach and acquire subject specific knowledge. This is indeed a formidable challenge, seen in the light of concerns voiced about teachers' proficiency and competency and the overall declining standards of English. On one hand, we have students who must learn mathematics and science content while they are still learning English (McKeon, 1994) and on the other, we have teachers, who themselves have proficiency problems with the new medium of instruction. Furthermore, the demands on the teachers are even greater as they have to in their own way ensure that the while teaching the subject matters in this case mathematics and science, they need to also improve students' comprehension of the subject matter, encourage interactions on the subject matters, and be aware of the language used in the classroom (McDonough, Mar 2009).

As such, the teachers may resort to the teaching of mathematics and science in a mixture of both the mother tongue and the target language. Studies however found that teaching instruction in the mother tongue or the first language does not impede the development of the second language (Bacherman, 2007; Tong et al., 2008). Nevertheless the use of mother tongue instruction has to be limited and selective in nature as consistent reliance on translation will not only affect the learners' language development but also discourage the learners from using the target language (Hong, 2008). Hence, the aim of teaching Mathematics and Science in English will meet an abrupt end. However when the competency of English teachers themselves becomes questionable, what more can we expect of teachers of mathematics and science? These teachers who are not language specialists will have to cope with the double demand of transmitting content as well as language. Will they be able to cover their subject area in an accurate and effective manner?

Therefore to understand the task at hand, it is important for us to understand the perceptions, knowledge, attitudes and readiness of these teachers towards the teaching of mathematics and science in English. As Pandian (2002) asserts, what teachers know and can do, affect all the core tasks of teaching. Furthermore, numerous studies (Gambrell, 1996; Chakravarthy, 1997; Pandian, 1999) have stressed the roles of teachers in influencing the behaviour of students. With this in mind, the purpose of this study is to investigate:

- i. The reaction of these teachers to using English as the medium of instruction
- ii. The problems encountered by these teachers in using English in the classroom
- iii. Availability of language support systems.

2. Methodology

This study sought to obtain some feedback from educators teaching mathematics and science in one of the pre-university institutions in the Northern part of Malaysia, in respect to the change in the medium of instruction.

2.1 Instruments

A set of questionnaire were administered to the subjects to determine teachers' English language command as well as problems that they faced using English in the teaching of mathematics and science. The questionnaire would also solicit selected personal background information of the subjects and statements related to teacher views and teaching practices in regard to teaching mathematics and science in English. The choice of answers was given on a Likert scale ranging from 'always' to 'never'. Next, semi-structured interviews were also conducted on a smaller sample of respondents for cross-validation purposes.

2.2 Subjects

A total of 26 educators currently teaching Mathematics and Science in the institution participated in the study (Figure 1). These educators teach mathematics, biology and chemistry. The subjects comprised three male and 23 female teachers. All 26 subjects have at least a passed in English at the SPM level (equivalent to GCE 'O' levels). Meanwhile, figure 2 illustrates that the majority of the teachers had at least five years teaching experience.

2.3 Data analysis

Both qualitative and quantitative data analyses were used in the study. The subjects' responses were analyzed using

descriptive statistics. Percentages and frequencies of their responses to the items related to their reaction to the change in the medium of instruction, the problems encountered in terms of the use of English in the classroom, their awareness of scientific and mathematical discourse and the support available to them were calculated. Interview data were qualitatively analyzed with initial descriptive codes being assigned to teachers' responses. Related codes were then grouped according to categories and common themes (Bogdan and Biklen, 2003). Illustrative quotations representing each theme are used to support findings of the survey.

3. Results and discussion

3.1 Problems in using English as a medium of instruction

Table 1 presents the different problems in using English as a medium of instruction. It was found that 80.8% of the respondents felt that they had problems in adjusting with the number of new English words to be learnt as a result of the change in policy. 92.3% of the respondents had problems using new terms or words correctly. This is comprehensible since all of them were trained in the Malay medium. Further, most had been teaching Mathematics and Science in the Malay language for at least five years. In addition to this, 88.5% of the teachers found it difficult to express themselves correctly in English. However, 53.8% of the teachers involved in this study said that they had no problems acclimatising themselves with the use of English in teaching Mathematics and Science. This is perhaps due to the efforts taken by the Ministry of Education to reduce the problems by introducing courses and programmes to facilitate the transition from the Malay medium to English.

When the announcement regarding the policy was made, 46.6 % of the subjects indicated shock and feelings of inadequacy in coping with the task (Table 1). One respondent explained: "Of course, I was shocked at first, my training has been in BM but after several ETeMS courses I am gaining my confidence. But the first few years was terrible. Anyway, this is a do or dies mission, we have to do it and I am getting used to it". One respondent mentioned: "Despite several years of teaching in English, I still need help with my English. I'm afraid of not using correct grammar when I teach. There were times when I felt really ashamed as my students corrected my sentences".

It was found that the main problem encountered by teachers was in explaining concepts in English. One teacher responded: "My students cannot understand me when I explain concepts. I need to use Bahasa Melayu. They understand simple instructions in English but it is difficult to make them understand science concepts in English". Further, 85.2% of the respondents indicated that they had problems explaining concepts in English and 81.8% admitted to using Bahasa Melayu (L1) to give explanations when faced with a breakdown in communication when using English as illustrates in Table 1 as one respondent said: "What am I to do? I have to use BM, if not, how am I to finish the syllabus?" The purpose of introducing English as the medium of instruction in the teaching and learning of mathematics and science is mainly to enable students to keep up with the developments in science and technology by making it possible for them to access this information which is mainly available in the English language. Teachers of science and mathematics generally understand this need and are trying to facilitate this move. However, some of these teachers feel that they themselves lack the necessary language skills to teach in English. Therefore, there is obviously a need for sustained content specific language input for the personal language development of these teachers. As these teachers play an important role in modelling good language practices in their classrooms, it then becomes crucial for them to master the language elements of their content subject. This is consistent to what several researchers have reiterated on the need to address teachers' language development programme focussing on in-depth language instruction, cultural diversity and adaptation of knowledge to instruction (Janzen, Mar 2008).

In terms of language problems in the classroom, it is alarming to note that 81.8% of the respondents studied used the L1 (Bahasa Melayu) to explain concepts when students faced problems in understanding these concepts in English (see Table 1). These teachers maintained that students' low English proficiency was the main cause for using Bahasa Melayu in class.

Whilst the Ministry of Education has initiated nation-wide training to address language problems faced by teachers teaching Mathematics and Science in English, the same cannot be said for students who are required to learn Mathematics and Science in English. Apart from the English lessons that are mandatory, these students have not been given extra language support to help them deal with academic content that is in English. The kind of language associated with the learning of mathematics and science is very different from general English. Scientific and mathematical discourses are less contextualised and require high cognitive levels of comprehension. Cummins (1986) suggests that there are two levels of language proficiency: the basic interpersonal communicative skills (BICS) and academic language proficiency (CALP). CALP involves language that is context-reduced and highly demanding cognitively. Cummins points out that in order to perform effectively in mathematics and science, students would need to develop CALP.

Furthermore, one of the reasons for teaching and learning mathematics and science in English was to provide opportunities for students to engage in the use of the language. Seen in this light, the use of L1 in the classroom is

worrying. While it is necessary to some extent to draw upon background understanding and literacy in the first language, it is dangerous to rely on the L1 as a crutch. As Bowering (2003) points out, limited use of *Bahasa Melayu* in the classroom will be of great benefit in helping students meet the challenge presented by English but total translation as an easy way out defeats the purpose of teaching these subjects in English. Instead these teachers should be exposed to alternative instructional approaches that use a wide range of scaffolding strategies to communicate meaningful input to their students. In this manner the content taught is expressed to suit the proficiency level of their students. Perhaps it is time for these teachers to recognise that subjects such as science should be viewed as an active process of developing ideas, rather than as a static body of already-existing knowledge to be passed on to students (Main & Eggen, 1991).

3.2 Problems encountered in the classroom

Table 2 illustrates the problems in the classroom. It was found that 70.5% of the respondents indicated that there was a difference between general English and the language of mathematics and science. Due to this, 65.4% of the respondents expressed the difficulty in engaging the class discussion in English. Furthermore, 73.1% felt that responding to students in English is also a problem. Additionally, 73.1% responded that they have difficulty in writing reports and preparing teaching materials in English and 76.9% expressed their difficulty in providing in English. However, interviews with the respondents revealed that these teachers are not clear about the linguistic features of their content subject. As one respondent explained: "I know I have to help them with the language, but I do not know how to do this, we were not taught how in university". Therefore, these teachers are unable to help their students to cope with academic language.

Other problems mentioned by the respondents interviewed were related to the textbook and multimedia courseware provided by the Ministry. The textbook was said to be too brief with inadequate examples and descriptions and thus was not very useful, especially for LEP (Low English Proficiency) students. The multimedia courseware was also said to be unsuitable for LEP students, as they were not able to understand the language used to deliver the content. A respondent pointed out: "The CDs are good but my students don't understand so I have to stop and translate for them".

More problems mentioned by the teachers are related to the prescribed textbook and the multimedia courseware supplied by the Ministry. Mohan (1990) points out that in many content classes reading a textbook is the main means of studying the content to be learned. Mohan also further explains that students' success in understanding their textbook depends on two factors — the content factor and the language factor. Mohan maintains that the language factor is actually knowledge that is related to the formal organisational structures of different types of texts. This knowledge of text types actually falls within the domain of the language teacher. Thus successful reading of content textbooks is actually dependent on having content knowledge and knowledge of text types. Therefore to facilitate successful reading among LEP students, joint action by the mathematics, science and language teachers is required.

3.3 Availability of Language Support

Table 3 illustrates the types of language support attained by the teachers. Apart from the ETeMS courses, teachers of mathematics and science are supposed to get language support from the "buddy system" whereby they can get help from identified resource persons in their respective colleges. It was found that 70.4% of the respondents indicated that they have language support from the "Buddy" and "Critical friend" assigned to help them. Interviews with respondents revealed that "help" in this sense meant assistance mainly with vocabulary and grammar. Respondents also indicated that they were unable to use self-learning materials such as the multimedia courseware and grammar books provided by the Ministry due to lack of time.

In terms of language support from the English panel, 80.7% of the respondents indicated that their English counterparts provided assistance. Interviews with the respondents disclosed that this assistance was mainly with vocabulary and grammar. It was found that 76.2% of the respondents indicated that they often discussed language problems related to the teaching of mathematics or science with their English counterparts. In fact, according to the respondents, their English counterparts have been helping them to the extent of even organizing program for the teachers.

In terms of collaborative teaching between the mathematics and science teachers with their English counterparts, 36.4% of the respondents claimed that they do collaborate with their colleagues. However, the interview with respondents revealed that 'collaboration' in this sense meant using their English counterparts as a source of reference when they have difficulties with grammar or vocabulary. One of the respondents said: "Yes, the English teachers help us. We always refer to them for meanings of words that we are not sure of or when we don't know how to say something in English". It was found that 87.5% of the respondents felt that the multimedia courseware supplied by the Ministry to teach science and mathematics is well planned and effective in terms of content. However, respondents who were interviewed claimed that these materials were more suitable for proficient students. Most respondents maintained that LEP students had trouble following the content presented because of language difficulties.

Accordingly, joint action is the kind of collaboration that is required to ensure success in using English as the medium of instruction. In order to help LEP students to overcome linguistic barriers in the course of learning mathematics and science, the language teacher together with the mathematics or science teacher must assess the needs and required

language skills of these students (Dale and Cuevas, 1987). Of course this sort of action requires extended time and effort on the part of the teachers and thus may not be practicable in our present school context. However, governing curricula bodies such as the Curriculum Development Center or joint working-committees at district or state levels could look into this suggestion.

4. Conclusion and Recommendation

The findings of this study suggest that teachers of mathematics and science recognise the need for the change in the medium of instruction and are reacting positively to this change. However, it is apparent that these teachers are experiencing difficulties not only in terms of their own language inadequacies, but also the management of the language development of their students in respect to their content subject. On the other hand, the prevailing language support mechanisms do not completely meet their needs. Therefore, it is important that measures are taken to support these teachers in the teaching of science and mathematics in English.

As a result, the teaching of science and mathematics in English should not be left to chance. The failure of these teachers to master English will be detrimental as they would not only affect the students' language ability but also the dissemination of the content of science and mathematics to the students.

As such in order to successfully implement the teaching of science and mathematics in English, policy makers and teacher educators must deliberate and focus on the needs of the teachers concerned. If that is failed, then perhaps it is probably time to look into the possibility of reverting to the teaching of science and mathematics in the mother language.

Among the things that can be considered is improving the teachers' language competence. Teachers may need to go through language transition programs where improving the language competence of the teachers will be the focus. However, these transition programs should not be conducted by English language specialists but instead handle by Science and Mathematical content specialists. In these programs, the teachers will not only be exposed to English language per se but also will be observing the language in action.

The study, however, is not without its limitation. The sample of the study was too small to generalize the findings throughout the country. A study with bigger sampling and diverse geographical location may provide different results. Thus, it is recommended that a new study should be conducted with bigger sampling and diverse geographical location.

Furthermore, the study focused only on the teachers. A study focusing on the reactions, receptions and performance of the students on the change in the teaching science and mathematics should be explored.

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Table 1. Problems Using English as a Medium of Instruction

Problem	%
English Vocabulary to be Learnt	80.8
Using New Terms or Words Correctly	92.3
Expressing Correctly in English	88.5
Acclimatising with the Use of English in Teaching	46.2
Coping with task	46.6
Explaining concepts in English	85.2
Using L1 in the class	81.1

Table 2. Problems in the Classroom

Problems	%
Differences in the language	70.5
Engage Class Discussion in English	65.4
Responding to Students in English	73.1
Writing Report/Teaching Materials in English	73.1
Providing Examples in English	76.9

Table 3. Types of Language support

Language support	%
Buddy	70.4
Grammar/vocabulary support from English Colleague	80.7
Subject matter language problems	76.2
Collaborations	36.4
Multimedia courseware	87.5

Percent

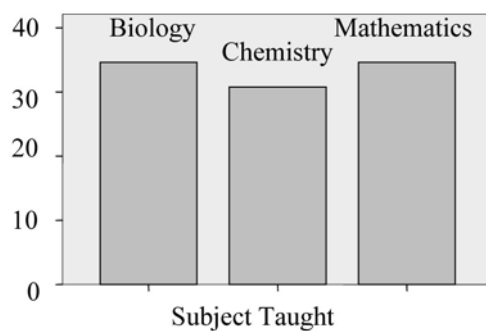


Figure 1. Subject Taught

Percent

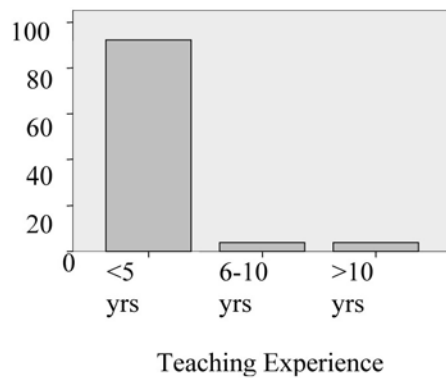


Figure 2. Teaching Experience